**Centre for Remote Imaging, Sensing and Processing (CRISP)**
**National University of Singapore**

# Tree Counting Software (Trial Version 1.0), April 2003

## User Manual



## Introduction

The Tree Counting Software detects tree crowns in high resolution aerial photographs or satellite imagery. It is assumed that tree crowns in the input image appear brighter than the background, and individual tree crowns are discernible. In the case where the tree crowns are darker than the background, the inverse image is used instead of the original image. Thus, the tree detection procedure will not work well if there is no sufficient contrast between the tree crowns and the background, or if the tree crowns merge together with no clear boundary between individual crowns.

The tree detection procedure does not use a simple intensity threshold for tree detection. Even though the tree crowns are generally brighter (or darker) than the background, different tree crowns have different intensity level and there are local intensity fluctuations within each tree crown. Hence, a simple intensity threshold cannot be used to detect individual tree crowns. The tree detection procedure in the Software uses intensity gradient instead. It makes use of the concept of curvature in differential geometry to detect the edge pixels of each tree crown, and forms a model of intensity profile for each crown. This procedure is done over a range of spatial scale levels, for all pixels in a demarcated region-of-interest (ROI). A local maximum filter is applied to extract the location of each tree crown. After tree detection, the tree count in the ROI is obtained. An image with the locations of detected trees superimposed on the original image can be displayed and saved as a separate file.

## Installation

The whole software package is contained in a single executable file "**TreeCounting.exe"** that runs under Microsoft Windows 98/2000/XP. The Software was developed and tested on a Windows 2000 platform, and has not been thoroughly tested on the other Windows operating systems. Create a new directory named "TreeCounting" under the "C:\Programe Files" tree and copy this executable file to this directory. Consult the MS Windows documentations on the procedure to create a link to the TreeCounting program in the Windows Start Menu or Desktop.

**Running TreeCounting**

1. Start the TreeCounting program from MS Windows.

2. Click on the "New Image" button. Select an input file and click OK to load the image. Only images saved in the tiff format is supported.

3. Click on the "Detect Trees" button. An input window titled "Parameters for Tree Detection" will appear.

4. Select either the "Use original image" (if tree crowns are brighter than background) or "Use inverse image" (tree crowns are darker than background) option. The default has been set to "Use inverse image".

5. Supply the values of the four input parameters (tree sizes, minimum scale level, scale level step, maximum scale level).

6. Click OK to start tree detection.

7. When tree detection is running, the program takes up most Windows resources. It is not advisable to run other programs if the input image occupies a large amount of RAM. The TreeCounting program window may not refresh itself if it is covered by other program windows. It will refresh when tree detection is done.

8. A notification window declaring "Tree detection done" will appear. Click OK to close the window. The number of trees detected and the ROI area are shown in two text boxes at the bottom.

9. Click the "Display Results" button to inspect the locations of the detected trees superimposed on the original image.

10. Click the "Save Result" button to save the displayed image to a file.

11. If you need to detect trees using a different set of input parameters but the same input image, go back to step 3.

12. To detect trees in a different input image, start from step 2.

13. To exit program, click the "Exit" button.

14. Click the "About" button to see a description of the program.

## Notes on Input Parameters

***Tree Size***: The nominal size (diameter) of trees to be detected, in pixels.

***Minimum Scale Level, Maximum Scale Level, Scale Level Step*:** The program detects trees using a multi-scale processing technique. Tree detection is done at a series of spatial scale levels, starting from the minimum scale level specified, incremented by the scale level step, up to the maximum scale level. So the number of scale levels to be processed is (Maximum scale level - Minimum scale level)/Scale level step + 1. The processing time increases significantly if this number is too large. To speed up processing, a larger scale level step may be used, but it may compromise the detection accuracy. The optimal values of these four parameters are expected to be different for different tree types and image resolution.

## Notes on Image Preprocessing

### *Regions of Interest*

The full version of TreeCounting includes a module for delineating regions of interest on the input image so tree detection will be performed only for pixels locating inside the ROIs. This module is not available in the Trial version. The Trial version assumes the whole image to be the ROI. Thus, it is advisable to preprocess the input image such that all pixels outside the desired ROI be set to a uniform grey level value (white if the tress are darker than background or black if tress are brighter). This procedure can be easily done using a standard off-the-shelf image processing software.

### *Image Contrast Stretching*

The tree detection procedure performs better if there is good contrast between tree crowns and background. It is advisable to perform a simple contrast enhancement, especially "haze-removal" (i.e. subtracting global minimum from each image pixel), on the image.

### *Spatial Filtering*

It is not necessary to pre-filter the input image (smoothing or sharpening) since the TreeCounting software already implements a special filter optimized for tree detection. The effects of pre-filtering the input image has not been tested.

**Program Log File**

Every time a new input image is loaded, a log file for this image is created in the same directory as the one where the input image file resides. The log file has a file name of the form "TCyyyymmdd-hhmmss-LOG.txt" where yyyymmdd is the date and hhmmss is the time of the log file creation. All tree detection actions are logged. The log file contains the input file name, start time, input parameters, ROI, results and stop time for every tree detection action.

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